STUDY OF HAND PREFERENCES ON SIGNATURE FOR RIGHT-HANDED AND LEFT-HANDED PEOPLES

Akram Gasmelseed and Nasrul Humaimi Mahmood
Faculty of Health Science and Biomedical Engineering,
Universiti Teknologi Malaysia, Johor, Malaysia.

ABSTRACT

Signature is the easiest way to issue the document. The problem of handwritten signature verification is a pattern recognition task used to differentiate two classes of original and fake signatures. The subject of interest in this study is about signature recognition that deals with the process of verifying the written signature patterns of human individuals and specifically between right-handed and left-handed people. The method that been used in this project is an on-line verification by using Intuos$_{TM}$ Graphics Tablet and Intuos pen as the data capturing device. On-line signature verification involved the capturing of dynamic signature signals such as pressure of pen tips, time duration of whole signature, altitude and azimuth. The ability to capture the signature and have it immediately available in a digital form for verification has opens up a range of new application areas about this topic.

KEYWORDS: *Signature verification, Intuos$_{TM}$ Graphics Tablet, Right-handed people, Left-handed people*

I. INTRODUCTION

Recent years, handwritten signatures are commonly used to identify the contents of a document or to confirm a financial transaction. Signature verification is usually made by visual check up. A person compares the appearance of two signatures and accepts the given signature if it is sufficiently similar to the stored signature, for example, on a credit card. When using credit cards, suitable verification of signature by a simple comparison using the human eye is difficult [1,2].

In order to prevent illegal use of credit cards, an electrical method for setting an auto identification device is desired. Biometrics, an identification technology that uses characteristics of the human body, characteristics of motion or characteristics of voice is often effective in identification [2]. However, identification technologies that use physical characteristics, especially fingerprints, often present difficulties as a result of psychological resistance. In contrast, automatic signature verification provides a great advantage in current social systems because the handwritten signature is often used for legal confirmation.

Theoretically, the problem of handwritten signature verification is a pattern recognition task used to differentiate two classes of original and fake signatures. A signature verification system must be able to detect forgeries and to reduce rejection of real signatures simultaneously [3]. Automatic signature verification can be divided into two main areas depending on the data gaining method. The methods are off-line and on-line signature verification [2,4].

In off-line signature verification, the signature is available on a document which is scanned to obtain its digital image representation. This method also identifies signatures using an image processing procedure whereby the user is supposed to have written down completely the signature onto a template that is later captured by a CCD camera or scanner to be processed. Another method is on-line signature verification. It used special hardware, such as a digitizing tablet or a pressure sensitive pen, to record the pen movements during writing [5,6,7]. On-line signature verification also involved the capturing of dynamic signature signals such as pressure of pen tips, time duration of whole signature and velocity along signature path.

In the past few years, there have been a lot of researches [8,9] regarding signature verification and signature recognition. Unfortunately, none of them specify the research and focusing on hand

preferences. The subject of interest in this research is about signature recognition that deals with the process of verifying the written signature patterns of human individuals and specifically among right-handed and left-handed people.

II. METHODOLOGIES

The method that had been used in this work is an on-line verification by using Intuos$_{TM}$ 9 X 12 Graphics Tablet and Intuos pen as the data capturing device. The information then had been processed using suitable software such as Capture 1.3, Microsoft Excel, MATLAB and MINITAB. The flowchart of methodology is shown in Figure 1.

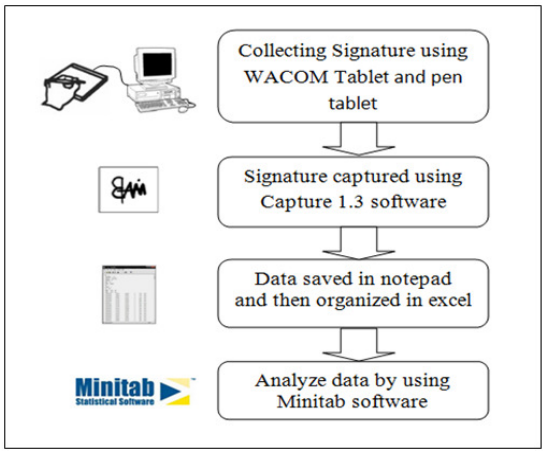

Figure 1: Flowchart of methodology

The first phase is about collecting the signature or data of individuals. Figure 2 shows the process of taking the signature. The data had been collected minimum 30 from right-handed and 30 left-handed people and taken from both of their hands (left and right). This will be totalled up all the data to 120. All the data will be detected and digitalis by Capture 1.3 software and then save in format of word pad.

Figure 2: Process of taking the signature

The data had arranged using Excel and simulate by using MATLAB and MINITAB. All the data were analysed using correlation and regression methods. The last phase of this work is to get the result from the analysis phase. All the data then, analysed between left-handed and right-handed people's signatures. The result and all the problems during this project will be discussed clearly. Lastly, overall conclusion and recommendation is summarized.

III. RESULT AND DISCUSSION

Linear correlation coefficient measures the strength of a linear relationship between two variables. This method measures the extent to which the points on a scatter diagram cluster about a straight line.

Table one shows the correlation coefficient for pressure, altitude and azimuth of the samples from different right-handed and left-handed peoples. From table 1, some analysis can be done accordingly.

Table 1: Correlation Measurement

Correlation	RR-RL (RH)	LL-LR (LH)	RR-LL (major)	RL-LR (minor)
Pressure	0.935	0.949	0.882	0.878
Altitude	0.487	0.893	0.779	0.920
Azimuth	-0.832	-0.623	0.925	0.500

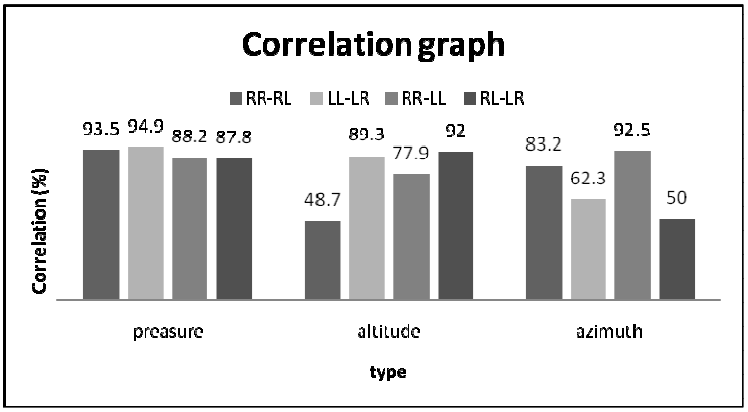

Figure 3: Graph of Correlation

Firstly, the analysis for right-handed people (RR-RL) and left-handed people (LL-LR) correlation has been made. For the right-handed people have a difference of 0.014 less than left-handed people for pressure correlation in this study. It same with the altitude correlation but it was less about 0.406 less than left-handed people. For azimuth correlation the result it was in negative value but right-handed people have higher difference than left-handed people about 0.209. The negative value showed the values of the data are in opposite directions. So it was recommended to apply the dominant for each correlation while doing this study to get maximum information for application.

Secondly, for major usage (RR-LL) and for minor usage hand (RL-LR) the higher value has been dominant for major usage compared to minor usage in term of pressure and azimuth correlation that are 0.004 and 0.425 respectively. For altitude correlation minor usage has a value of 0.141 greater than major usage. To get a measure for more general dependencies in the data, the percentage of the data also has been made. For a pressure correlation of LH people (94.9%) is higher than the correlation value of pressure for RH people (93.5%). The correlation value of altitude for LH people (89.3%) is also higher than the correlation value of pressure for RH people (48.7%). But, the correlation value of azimuth for LH people (62.3%) is lower than the correlation value of azimuth for RH people (83.2%).

The left-handed people have higher values of correlation compared to right-handed people for pressure and altitude. But for azimuth, right-handed people have higher correlation than left-handed people. From this result, it is advisable to use the left-handed people information or setting if using for pen pressure and also altitude. The right-handed people information or setting can be advisable to use for azimuth.

Figure 3 shows that the pen pressures have the higher percentage of correlation rather than altitude and azimuth for all types of hand usage. With this result, it is advisable to use the pen pressure to obtain the signature recognition.

Regression generally models the relationship between one or more response variables and one or more predictor variables. Linear regression models the relationship between two or more variables

using a linear equation. Linear regression gives a formula for the line most closely matching those points. It also gives an R-Squared (r^2) value to say how well the resulting line matches the original data points. The closer a line is to the data points, overall, the stronger the relationship.

Table 2: Regression Analysis

	Equation	R-Sq
PRES RR vs. ALT RR, AZM RR	PRES RR = - 3892 + 2.60 ALT RR + 2.44 AZM RR	69.4%
PRES LL vs. ALT LL, AZM LL	PRES LL = - 629 + 10.2 ALT LL - 2.10 AZM LL	82.3%
PRES RL vs. ALT RL, AZM RL	PRES RL = - 1265 + 9.30 ALT RL - 1.52 AZM RL	90.1%
PRES LR vs. ALT LR, AZM LR	PRES LR = - 25218 + 25.0 ALT LR + 11.8 AZM LR	79.4%
PRES RR vs. PRES RL	PRES RR = 114 + 0.787 PRES RL	87.5%
PRES LL vs. PRES LR	PRES LL = 101 + 0.772 PRES LR	90.1%
PRES RR vs. PRES LL	PRES RR = 77.0 + 0.985 PRES LL	77.9%
PRES RL vs. PRES LR	PRES RL = 83.9 + 0.946 PRES LR	77.0%
ALT RR vs. ALT RL	ALT RR = 353 + 0.392 ALT RL	23.7%
ALT LL vs. ALT LR	ALT LL = - 741 + 2.26 ALT LR	79.7%
ALT RR vs. ALT LL	ALT RR = 261 + 0.517 ALT LL	60.6%
ALT RL vs. ALT LR	ALT RL = - 581 + 1.92 ALT LR	84.6%
AZM RR vs. AZM RL	AZM RR = 3552 - 1.02 AZM RL	69.3%
AZM LL vs. AZM LR	AZM LL = 7326 - 5.37 AZM LR	38.8%
AZM RR vs. AZM LL	AZM RR = - 738 + 0.763 AZM LL	85.5%
AZM RL vs. AZM LR	AZM RL = - 268 + 2.91 AZM LR	25.0%

Table 2 shows all variables have the linear relationship that shown by the linear equations. For the right-handed people have the equation of "PRES RR = 114 + 0.787 PRES RL" and value of r^2 = 87.5%. The left-handed people have equation of "PRES LL = 101 + 0.772 PRES LR" and have higher values of r^2 that are 90.1%. The high value of r^2 shows that the pressure has a strong relationship for the right-handed and left-handed people. For the altitude and azimuth, the value of r^2 is less than 80%. This means there are weak relationships between them.

For the linear relationship between pen pressure, altitude and azimuth, table 2 shows that left-handed people have a value of r^2 that is 82.3% higher than right-handed people with 69.4%. But for the minor usage hand the r^2 value is higher for right-handed people with 90.1% rather than left-handed people with 79.4%. These results show that there are high linear relationship between pen pressure, altitude and azimuth for both of the people and also their major and minor usage hand.

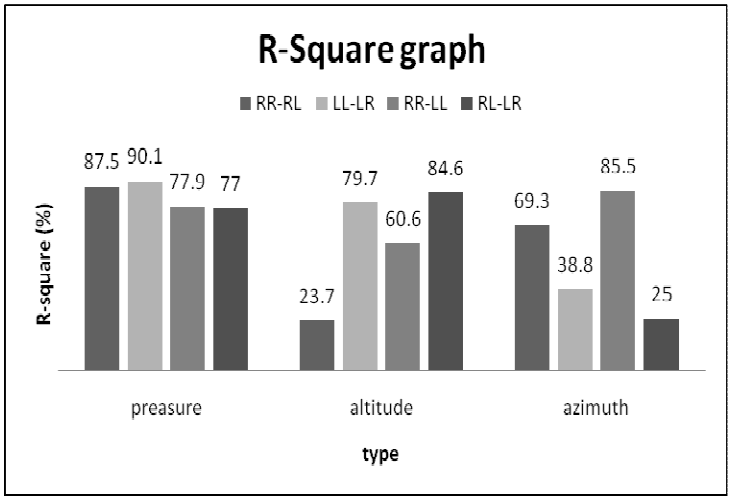

Figure 4: Graph of Regressions

Figure 4 shows that the pen pressures have the higher percentage of regression rather than altitude and azimuth for all types of hand usage. This also can be advised to use the pen pressure to obtain the signature recognition.

IV. CONCLUSION AND FUTURE WORKS

This work is about analyzing signature recognition especially on people's hand preferences by using correlation and regression methods. The left-handed people have higher values of correlation compared to right-handed people for pressure and altitude. But for azimuth, right-handed people have higher correlation than left-handed people. That means for each hand preference group are having their own parameters that can be consider during performing signature recognition between these two groups of people. From the regression method, the results show that there are high linear relationship between pen pressure, altitude and azimuth for both of the people and also their major and minor usage hand. Meaning that, all groups of data are having highly linear relationship between these three parameters. The resulting analysis, for pen pressure can be advisable to be obtained for signature recognition rather than altitude and azimuth. Pen pressure data analysis is showing the highest value of correlation and regression compared to the data of altitude and azimuth. This result indicates that the data from left-handed and right-handed people's signatures are highly related in term of pen pressure.

This research work can be extended in order to apply to the real world due to the market demand as an establish method or technique to verify the signatures. Some of further recommendation can be made. Firstly, the analysis can be extended by developing new software of signature recognition. The software will make the research more reliable and maybe can predict the outcome from the input signatures. The method that's been used is only using correlation and regression analysis to analyze all the data. By using several recognition algorithms, the research can be ended with more precise and trusted results. The numbers of data also should be increased to greater than 30 for each of the data groups. The physical poses and body position for person that give the signature also very important. They must have the same pose during the signature was taken. This will decrease the false of *Intuos* pen position that will affect on the altitude and azimuth of the signatures.

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Authors

A. GASMELSEED received his B.Sc. degree in Electrical Engineering and Informatics – major in Computer Engineering – and M.Sc degree in Electrical Engineering and Informatics from Budapest, Hungary, in 1993 and 1999, respectively. He received the PhD degree in Electrical Engineering from Universiti Teknologi Malaysia (UTM), Malaysia, in 2009. His research is in the areas of electromagnetic biological effects, biophotonics, and computer signal/image-processing application to biomedical engineering. Currently he is a Senior Lecturer at Faculty of Health Science and Biomedical Engineering, UTM.

N. H. MAHMOOD received his B.Sc. and M.Sc. degrees in Electrical Engineering from Universiti Kebangsaan Malaysia (UKM) and Universiti Teknologi Malaysia (UTM) respectively. He obtained his Ph.D. degree from the University of Warwick, United Kingdom. His research areas are biomedical image processing, medical electronics and rehabilitation engineering. Currently he is a Senior Lecturer at Faculty of Health Science and Biomedical Engineering, UTM.